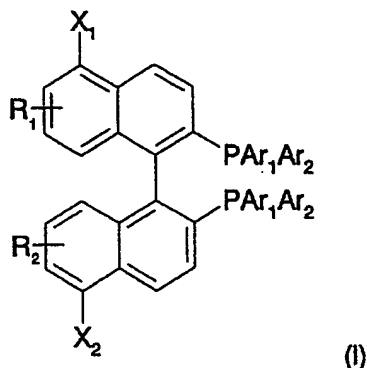


CLAIMS

1. A diphosphine in racemic form or in chiral form, corresponding to formula (I):



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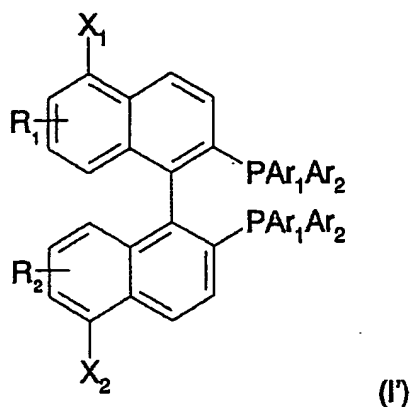
in said formula:

- $R_1$  and  $R_2$ , which may be identical or different, represent a hydrogen atom or a substituent,
- $Ar_1$  and  $Ar_2$  independently represent an alkyl, alkenyl, cycloalkyl, aryl or arylalkyl group,
- $X_1$  and  $X_2$ , which may be identical or different, represent:
  - . a group R, alkyl, alkenyl, alkynyl, cycloalkyl, aryl or arylalkyl,
  - . an alkyl group substituted with one or more halogen atoms, preferably fluorine, or with nitro or amino groups,
  - . a halogen atom chosen from bromine, chlorine and iodine,
  - . an -OH group,
  - . a group -O-COR<sub>a</sub>,
  - . a group -O-R<sub>a</sub>,
  - . a group -S-R<sub>a</sub>,
  - . a -CN group,
  - . a group derived from the nitrile group such as:
    - . a -CH<sub>2</sub>-NH<sub>2</sub> group,

- . a -COOH group,
  - . a group derived from the carboxylic group such as:
    - . a group -COOR<sub>a</sub>,
    - 5 . a -CH<sub>2</sub>OH group,
    - . a group -CO-NH-R<sub>b</sub>,
    - . a group derived from the aminomethyl group such as:
      - . a group -CH<sub>2</sub>-NH-CO-R<sub>b</sub>,
      - 10 . a group -CH<sub>2</sub>-NH-CO-NH-R<sub>b</sub>,
      - . a group -CH<sub>2</sub>-N=CH-R<sub>a</sub>,
      - . a -CH<sub>2</sub>-N=C=O group,
      - . a -CH<sub>2</sub>-NH<sub>4</sub><sup>+</sup> group,
      - . a group comprising a nitrogen atom such as:
        - 15 . a group -NHR<sub>a</sub>,
        - . a group -N(R<sub>a</sub>)<sub>2</sub>,
        - . a group -N=CH-R<sub>a</sub>,
        - . an -NH-NH<sub>2</sub> group,
        - . an -N=N<sup>+</sup>=N<sup>-</sup> group,
        - 20 . an -N=C=O group,
        - . a magnesium or lithium atom,
- in the various formulae, R<sub>a</sub> represents an alkyl, cycloalkyl, arylalkyl or phenyl group and R<sub>b</sub> has the meaning given for R<sub>a</sub> and also represents a naphthyl
- 25 group.

2. The diphosphine as claimed in claim 1, bearing two functional groups capable of reacting with one or more polymerizable monomers corresponding to the general

30 formula (I'):



in said formula:

- $R_1$  and  $R_2$ , which may be identical or different, represent a hydrogen atom or a substituent,
- 5    -  $Ar_1$  and  $Ar_2$  independently represent an alkyl, alkenyl, cycloalkyl, aryl or arylalkyl group,
- $X_1$  and  $X_2$ , which are identical, represent:
  - . an -OH group,
  - . a -CH<sub>2</sub>OH group,
  - 10    . a -CH<sub>2</sub>-NH<sub>2</sub>,
  - . a -COOH group,
  - . a group -COOR<sub>a</sub> in which R<sub>a</sub> represents an alkyl, cycloalkyl, arylalkyl or phenyl group,
  - . an -N=C=O group,
  - 15    . a -CH<sub>2</sub>-N=C=O group.

3. The diphosphine as claimed in either of claims 1 and 2, characterized in that it corresponds to formula (I) or (I') in which  $Ar_1$  and  $Ar_2$  represent a (C<sub>1</sub>-C<sub>6</sub>)alkyl group, a phenyl group optionally substituted with one or more (C<sub>1</sub>-C<sub>6</sub>)alkyl or (C<sub>1</sub>-C<sub>6</sub>)alkoxy; or a (C<sub>4</sub>-C<sub>8</sub>)cycloalkyl group optionally substituted with one or more (C<sub>1</sub>-C<sub>6</sub>)alkyl groups.

25 4. The diphosphine as claimed in one of claims 1 to 3, characterized in that it corresponds to formula (I) or (I') in which  $R_1$  and  $R_2$ , which may be identical or different, represent a hydrogen atom or an alkyl or

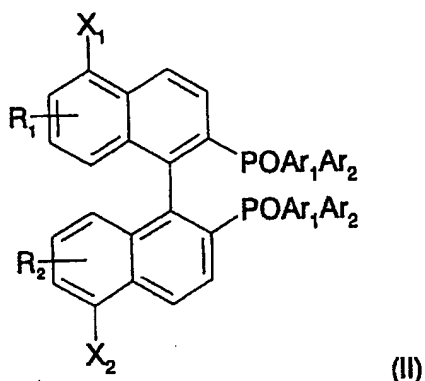
alkoxy group containing from 1 to 4 carbon atoms.

5. The diphosphine as claimed in one of claims 1 to 4, characterized in that it corresponds to formula (I) or (I') in which  $Ar_1$  and  $Ar_2$  represent a phenyl group and  $R_1$  and  $R_2$  represent a hydrogen atom.

6. The diphosphine as claimed in one of claims 1 to 5, characterized in that it corresponds to formula (I) or (I') in which  $X_1$  and  $X_2$ , which are identical, represent:

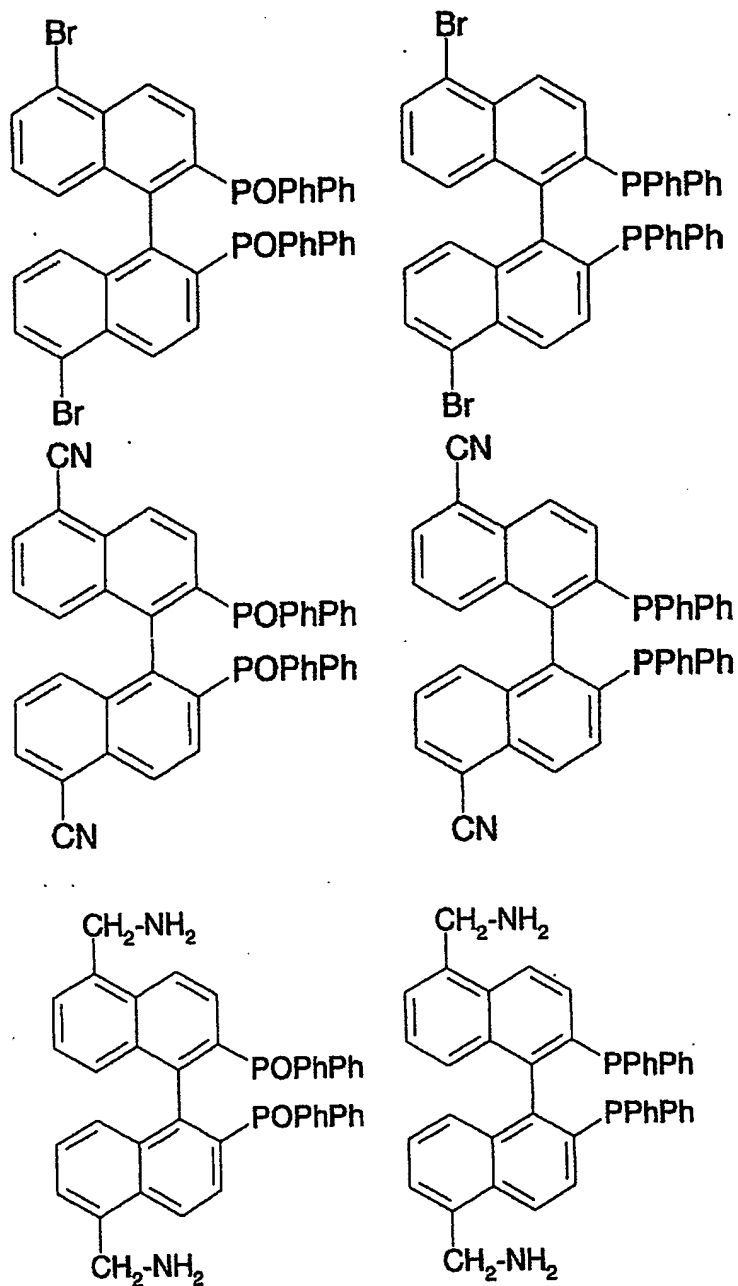
- . a halogen atom, preferably a bromine or chlorine atom,
- . an alkyl group substituted with one or more fluorine atoms,
- . a -CN group,
- . a -CH<sub>2</sub>-NH<sub>2</sub> group,
- . a -COOH group.

7. A diphosphine in dioxide form, in racemic form or in chiral form corresponding to formula (II):

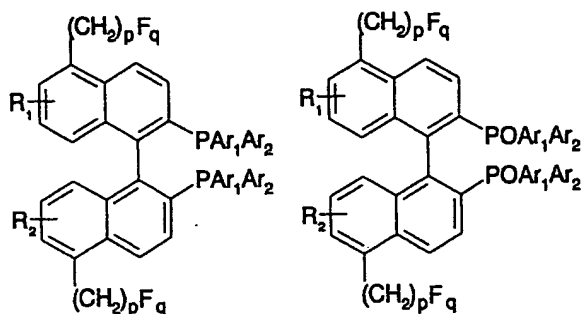


in which  $X_1$ ,  $X_2$ ,  $R_1$ ,  $R_2$ ,  $Ar_1$  and  $Ar_2$  have the meaning given for formula (I) in one of claims 1 to 5.

8. The diphosphine or diphosphine in dioxide form as claimed in one of claims 1 to 7, characterized in that it corresponds to one of the following formulae:

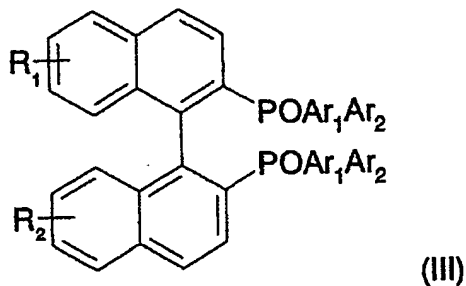


9. The diphosphine or diphosphine in dioxide form as  
 claimed in one of claims 1 to 6, characterized in that  
 5 it corresponds to one of the following formulae:



in which  $p$  is between 1 and 15 and preferably between 6 and 10,  $q$  is between 3 and 21 and preferably between 13 and 25, and  $R_1$ ,  $R_2$ ,  $Ar_1$  and  $Ar_2$  have the meaning given  
5 for formula (I) in one of claims 1 to 5.

10. A process for preparing a diphosphine or a diphosphine in dioxide form corresponding to formula (I), (I') or (II) described in one of claims 1 to 9,  
10 characterized in that it comprises at least one step of halogenation in position 5,5' of a compound of formula (III):



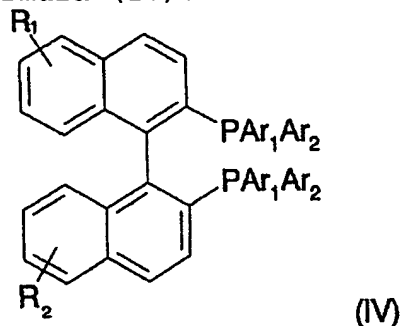
in said formula:

15 -  $R_1$ ,  $R_2$ ,  $Ar_1$  and  $Ar_2$  have the meaning given above in one of claims 1 to 5.

11. The process as claimed in claim 10, characterized in that the halogenation is performed in an inert  
20 aprotic solvent, preferably 1,2-dichloroethane.

12. The process as claimed in claim 10, characterized in that the diphosphine in dioxide form of formula

(III) is obtained by oxidation of the chiral or achiral diphosphine of formula (IV):

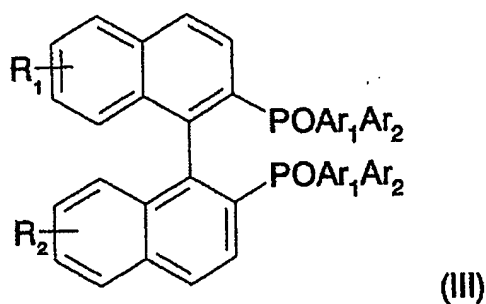


in said formula:

- 5 -  $R_1$ ,  $R_2$ ,  $Ar_1$  and  $Ar_2$  have the meaning given above in one of claims 1 to 5.

13. A process for preparing the diphosphine corresponding to formula (I) or (I') described in one of claims 1 to 6, in which  $X_1$  and  $X_2$  represent a halogen atom, characterized in that it comprises the following steps:

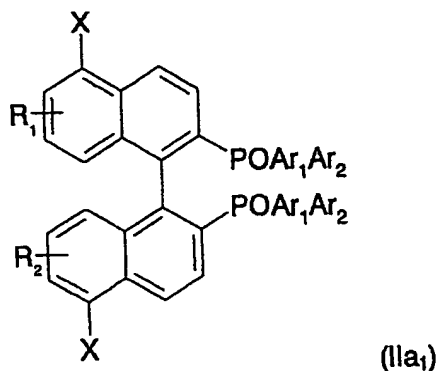
i) performing the halogenation in the 5,5' position of a compound of formula (III):



in said formula:

- $R_1$ ,  $R_2$ ,  $Ar_1$  and  $Ar_2$  have the meaning given above in one of claims 1 to 5,

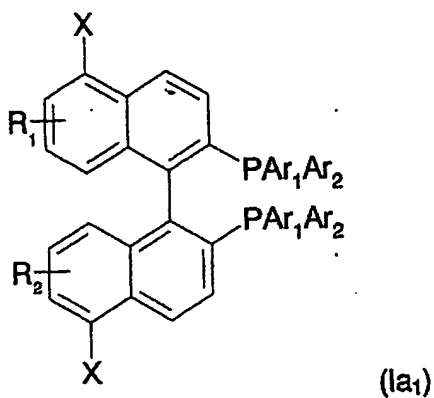
using a halogen and in the presence of iron, so as to obtain the corresponding dihalo compound of formula:



in said formula:

- X represents a chlorine, bromine or iodine atom,
  - R<sub>1</sub>, R<sub>2</sub>, Ar<sub>1</sub> and Ar<sub>2</sub> have the meaning given above in
- 5 one of claims 1 to 5;

ii) performing the reduction of the diphosphine in dioxide and dihalo form in position 5,5' of formula (IIa<sub>1</sub>), into the diphosphine of formula (Ia<sub>1</sub>):



10 in said formula:

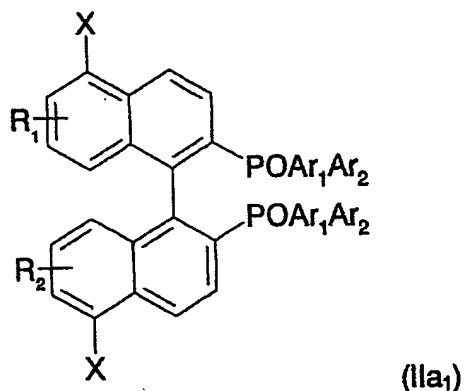
- X represents a chlorine, bromine or iodine atom,
  - R<sub>1</sub>, R<sub>2</sub>, Ar<sub>1</sub> and Ar<sub>2</sub> have the meaning given above in
- one of claims 1 to 5.

15 14. A process for preparing the diphosphine corresponding to formula (I) or (I') described in one



of claims 1 to 6 in which  $X_1$  and  $X_2$  represent a -CN group, characterized in that it comprises the following steps:

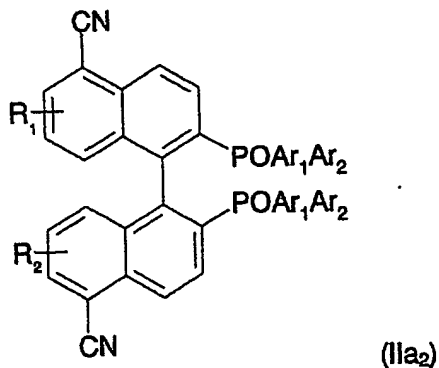
- i) performing the substitution of the two halogen atoms, preferably bromine atoms, with cyano groups by reacting the diphosphine in dioxide and dihalo form in position 5,5' of formula (IIa<sub>1</sub>):



in said formula:

- 10    - X represents a chlorine, bromine or iodine atom,  
       -  $R_1$ ,  $R_2$ ,  $Ar_1$  and  $Ar_2$  have the meaning given above in one of claims 1 to 5,

using a suitable nucleophilic reagent so as to obtain the corresponding dicyano compound (IIa<sub>2</sub>):

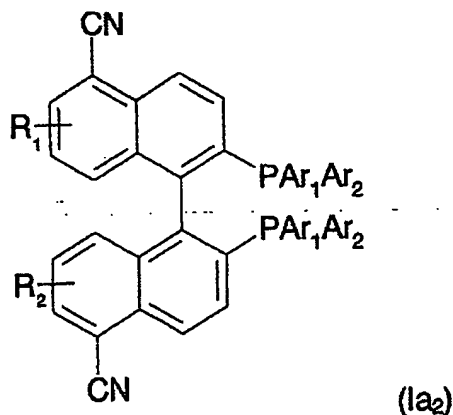


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in said formula:

- $R_1$ ,  $R_2$ ,  $Ar_1$  and  $Ar_2$  have the meaning given above in

one of claims 1 to 5,  
 ii) performing the reduction of the diphosphine in dioxide and dicyano form in position 5,5' of formula (IIa<sub>2</sub>) into the diphosphine of formula (Ia<sub>2</sub>):



5

in said formula:

- R<sub>1</sub>, R<sub>2</sub>, Ar<sub>1</sub> and Ar<sub>2</sub> have the meaning given above in one of claims 1 to 5.

10 15. The process as claimed in claim 14, characterized in that the cyanation is performed using copper cyanide.

16. The process as claimed in either of claims 13 and  
 15 14, characterized in that the reduction of the diphosphine in dioxide form is performed using a hydrogenosilane of formula:



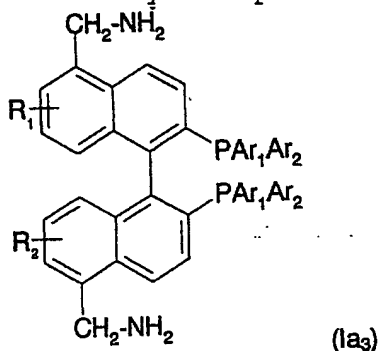
in said formula:

20 - R<sub>α</sub>, R<sub>β</sub> and R<sub>δ</sub>, which may be identical or different, represent a hydrogen atom, an alkyl group containing from 1 to 6 carbon atoms, a phenyl group or a chlorine atom,  
 - at most two of the groups R<sub>α</sub>, R<sub>β</sub> and R<sub>δ</sub> represent a

hydrogen atom.

17. The process as claimed in claim 16, characterized in that the reduction of the diphosphine in dioxide form is performed using a mixture of  $\text{PhSiH}_3$  (or PMHS) and  $\text{HSiCl}_3$ .

18. A process for preparing the diphosphine corresponding to formula (I) or (I') described in one of claims 1 to 6 in which  $X_1$  and  $X_2$  represent a  $-\text{CH}_2-\text{NH}_2$  group, characterized in that it comprises a step of reducing the cyano group of the compound of formula ( $\text{Ia}_2$ ) described in claim 14, leading to the corresponding diaminomethyl compound of formula ( $\text{Ia}_3$ ):



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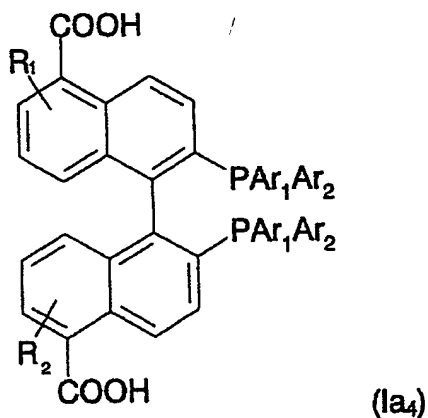
in said formula:

-  $R_1$ ,  $R_2$ ,  $\text{Ar}_1$  and  $\text{Ar}_2$  have the meaning given above in one of claims 1 to 5.

19. The process as claimed in claim 18, characterized in that the reduction is performed using lithium aluminum hydride ( $\text{LiAlH}_4$ ).

20. A process for preparing the diphosphine corresponding to formula (I) or (I') described in one of claims 1 to 6 in which  $X_1$  and  $X_2$  represent a  $-\text{COOH}$  group, characterized in that it comprises the steps defined in claim 14 and then a step consisting in

treating, in acidic medium or in basic medium, the compound of formula (Ia<sub>2</sub>), so as to obtain the corresponding carboxylic acid of formula (Ia<sub>4</sub>):



5 in said formula:

- R<sub>1</sub>, R<sub>2</sub>, Ar<sub>1</sub> and Ar<sub>2</sub> have the meaning given above in one of claims 1 to 5.

21. A process for preparing the diphosphine  
 10 corresponding to formula (I) or (I') described in one of claims 1 to 6 in which X<sub>1</sub> and X<sub>2</sub> represent a group -COOR<sub>a</sub> in which R<sub>a</sub> represents an alkyl, cycloalkyl, arylalkyl or phenyl group, characterized in that the direct esterification of the compound of formula (Ia<sub>4</sub>)  
 15 described in claim 20 is performed, in basic medium.

22. A process for preparing the diphosphine  
 corresponding to formula (I) or (I') described in one of claims 1 to 6 in which X<sub>1</sub> and X<sub>2</sub> represent a -CH<sub>2</sub>OH  
 20 group, characterized in that reduction of the compound of formula (Ia<sub>4</sub>) described in claim 20 is performed, preferably using LiAlH<sub>4</sub> or NaH.

23. A process for preparing the diphosphine  
 25 corresponding to formula (I) or (I') described in one of claims 1 to 6 in which X<sub>1</sub> and X<sub>2</sub> represent a group

-CO-NH-R<sub>b</sub>, in which R<sub>b</sub> represents an alkyl, cycloalkyl, arylalkyl, phenyl or naphthyl group, characterized in that the reaction of the compound of formula (Ia<sub>4</sub>) described in claim 20 is performed with an amine R<sub>b</sub>-NH<sub>2</sub> in the presence of a coupling agent.

24. A process for preparing the diphosphine corresponding to formula (I) or (I') described in one of claims 1 to 6 in which X<sub>1</sub> and X<sub>2</sub> represent a group -CH<sub>2</sub>-NH-CO-R<sub>b</sub>, in which R<sub>b</sub> represents an alkyl, cycloalkyl, arylalkyl, phenyl or naphthyl group, characterized in that the reaction of the compound of formula (Ia<sub>3</sub>) described in claim 18 is performed with an acid R<sub>b</sub>-COOH in the presence of a coupling agent.

25. A process for preparing the diphosphine corresponding to formula (I) or (I') described in one of claims 1 to 6 in which X<sub>1</sub> and X<sub>2</sub> represent a group -CH<sub>2</sub>-NH-CO-NH-R<sub>b</sub>, in which R<sub>b</sub> represents an alkyl, cycloalkyl, arylalkyl, phenyl or naphthyl group, characterized in that the reaction of the compound of formula (Ia<sub>3</sub>) described in claim 18 is performed, with an isocyanate R<sub>b</sub>-NCO, generally in solvent medium.

26. A process for preparing the diphosphine corresponding to formula (I) or (I') described in one of claims 1 to 6 in which X<sub>1</sub> and X<sub>2</sub> represent a group -CH<sub>2</sub>-N=CH-R<sub>a</sub>, in which R<sub>a</sub> represents an alkyl, cycloalkyl, arylalkyl or phenyl group, characterized in that the reaction of the compound of formula (Ia<sub>3</sub>) described in claim 18 is performed, with an aldehyde R<sub>a</sub>-CHO.

27. A process for preparing the diphosphine corresponding to formula (I) or (I') described in one of claims 1 to 6 in which X<sub>1</sub> and X<sub>2</sub> represent a group

-CH<sub>2</sub>-N=C=O, characterized in that the reaction of the compound of formula (Ia<sub>3</sub>) with phosgene is performed.

28. A process for preparing the diphosphine  
 5 corresponding to formula (I) or (I') described in one of claims 1 to 6 in which X<sub>1</sub> and X<sub>2</sub> represent a -CH<sub>2</sub>-NH<sub>4</sub><sup>+</sup> group, characterized in that the reaction is performed by placing the compound of formula (Ia<sub>3</sub>) in contact with an acid, preferably hydrobromic acid, at room  
 10 temperature, in a suitable solvent capable of dissolving the compound of formula (Ia<sub>3</sub>).

29. A process for preparing the diphosphine  
 corresponding to formula (I) or (I') described in one  
 15 of claims 1 to 6 in which X<sub>1</sub> and X<sub>2</sub> represent, respectively, a group -NHR<sub>a</sub> or a group -N(R<sub>a</sub>)<sub>2</sub> in which R<sub>a</sub> represents an alkyl, cycloalkyl, arylalkyl or phenyl group, characterized in that the reaction, respectively, of the diphosphine in dioxide and dihalo  
 20 form of formula (IIa<sub>1</sub>) described in claim 13 and of an amine R<sub>a</sub>NH<sub>2</sub> or (R<sub>a</sub>)<sub>2</sub>NH is performed, followed by a reduction of the diphosphine in dioxide form as described previously in either of claims 16 and 17.

25 30. A process for preparing the diphosphine corresponding to formula (I) or (I') described in one of claims 1 to 6 in which X<sub>1</sub> and X<sub>2</sub> represent a group -N=CH-R<sub>a</sub> in which R<sub>a</sub> represents an alkyl, cycloalkyl, arylalkyl or phenyl group, characterized in that the  
 30 reaction of ammonia with the diphosphine in dioxide and dihalo form of formula (IIa<sub>1</sub>) described in claim 13 and then reaction of the amino group with a compound of the type R<sub>a</sub>-CHO is performed, followed by a reduction of the diphosphine in dioxide form as described previously in  
 35 either of claims 16 and 17.

31. A process for preparing the diphosphine corresponding to formula (I) or (I') described in one of claims 1 to 6 in which  $X_1$  and  $X_2$  represent an  $-N=C=O$  group, characterized in that it is obtained by reacting  
5 the compound of formula (Ia<sub>13</sub>) with phosgene.

32. A process for preparing the diphosphine corresponding to formula (I) or (I') described in one of claims 1 to 6 in which  $X_1$  and  $X_2$  represent an  $-NH-NH_2$   
10 group, characterized in that the reaction of hydrazine with the diphosphine in dioxide and dihalo form of formula (IIa<sub>1</sub>) described in claim 13 is performed, followed by a reduction of the diphosphine in dioxide form as described previously in either of claims 16 and  
15 17.

33. A process for preparing the diphosphine corresponding to formula (I) or (I') described in one of claims 1 to 6 in which  $X_1$  and  $X_2$  represent an  $-N=N^+=N^-$   
20 group, characterized in that the reaction of  $HN_3$  or  $NaN_3$  with the diphosphine in dioxide and dihalo form of formula (IIa<sub>1</sub>) described in claim 13 is performed, followed by a reduction of the diphosphine in dioxide form as described previously in either of claims 16 and  
25 17.

34. A process for preparing the diphosphine corresponding to formula (I) or (I') described in one of claims 1 to 6 in which  $X_1$  and  $X_2$  represent a  
30 hydrocarbon-based group R chosen from alkyl, alkenyl, alkynyl, cycloalkyl, aryl and arylalkyl groups, characterized in that the organomagnesium reagent corresponding to the diphosphine in dioxide and dihalo form of formula (IIa<sub>1</sub>) described in claim 13 is prepared  
35 by reacting said diphosphine with magnesium and then reaction of the reagent obtained with the halogenated

hydrocarbon  $R-X_0$  ( $X_0 = \text{Br or Cl}$ ), followed by a reduction of the diphosphine in dioxide form as described previously in either of claims 16 and 17.

5 35. A process for preparing the diphosphine corresponding to formula (I) or (I') described in one of claims 1 to 6 in which  $X_1$  and  $X_2$  represent an alkyl group substituted with one or more halogen atoms, preferably a perfluoroalkyl group, characterized in  
10 that the reaction of the diphosphine in dioxide and dihalo form of formula (IIa<sub>1</sub>) described in claim 13 with the corresponding iodo species  $I(\text{CH}_2)_p\text{F}_q$ , in which  $p$  is between 1 and 15 and preferably between 6 and 10 and  $q$  is between 3 and 21 and preferably between 13 and 25,  
15 is performed, in the presence of copper, optionally of a base and a polar solvent.

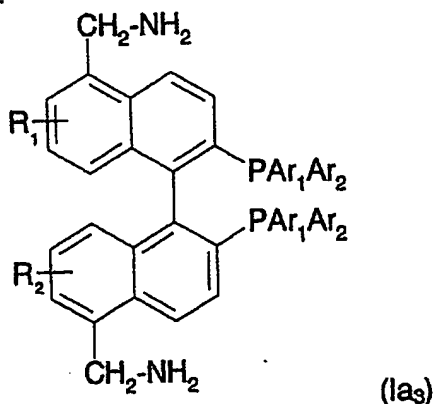
36. A process for preparing the diphosphine corresponding to formula (I) or (I') described in one  
20 of claims 1 to 6 in which  $X_1$  and  $X_2$  represent a hydroxyl group, characterized in that it is obtained from the diphosphine in dioxide and dihalo form of formula (IIa<sub>1</sub>) described in claim 13, according to an aromatic nucleophilic substitution reaction with  $-\text{OH}$ , followed  
25 by a reduction of the diphosphine in dioxide form as described previously in either of claims 16 and 17.

37. A process for preparing the diphosphine corresponding to formula (I) or (I') described in one  
30 of claims 1 to 6 in which  $X_1$  and  $X_2$  represent a group  $-\text{OCOR}_a$  in which  $R_a$  represents an alkyl, cycloalkyl, arylalkyl or phenyl group, characterized in that it is obtained by esterification of the diphosphine described in claim 36 with the carboxylic acid  $R_a\text{COOH}$  or  
35 derivative.



38. A polymer in racemic or optically active form, characterized in that it is obtained by reaction of a chiral or achiral diphosphine of formula (I') described in one of claims 2 to 5 with one or more polymerizable  
5 monomers.

39. The polymer as claimed in claim 38, characterized in that the diphosphine used corresponds to formula (Ia<sub>3</sub>) as follows:

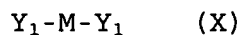


10

in said formula:

- R<sub>1</sub>, R<sub>2</sub>, Ar<sub>1</sub> and Ar<sub>2</sub> have the meaning given above in one of claims 1 to 5.

15 40. The polymer as claimed in either of claims 38 and 39, characterized in that the monomer reacted with the diphosphine corresponds to formula (X) below:



in which:

20

- M represents a divalent hydrocarbon-based group of aliphatic, alicyclic and/or aromatic nature,
- Y<sub>1</sub> represents a functional group, preferably a carboxylic, ester, hydroxyl, amino, isocyanato, aldehyde or ketone group.

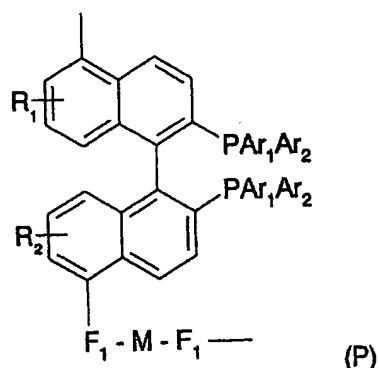
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41. The polymer as claimed in claim 40, characterized in that the monomer reacted with the diphosphine

corresponds to formula (X) in which M represents a C<sub>1</sub>-C<sub>12</sub> and preferably C<sub>1</sub>-C<sub>6</sub> alkylene chain; a cycloalkylene group, preferably cyclohexylene; an arylene group, preferably phenylene, tolylene or naphthalene.

5

42. A polymer in racemic or optically active form comprising the following repeating unit:



10 in which

- R<sub>1</sub> and R<sub>2</sub>, which may be identical or different, represent a hydrogen atom or a substituent,
- Ar<sub>1</sub> and Ar<sub>2</sub> independently represent an alkyl, alkenyl, cycloalkyl, aryl or arylalkyl group,
- 15 - M represents a divalent hydrocarbon-based group of aliphatic, alicyclic and/or aromatic nature;
- F<sub>1</sub> represents a functional group resulting from the reaction:
  - . of the group X<sub>1</sub> chosen from the following
  - 20 groups: aminomethyl, hydroxyl, hydroxymethyl, carboxylic, ester, isocyanato, isocyanatomethyl,
  - . and of the group Y<sub>1</sub> chosen from carboxylic, ester, hydroxyl, amino, isocyanato, aldehyde and ketone groups,
- 25 - the degree of polymerization is preferably between 2 and 100 and better still between 2 and 50.

43. The polymer as claimed in claim 42, characterized in that it corresponds to the formula (P) in which M represents a C<sub>1</sub>-C<sub>12</sub> and preferably C<sub>1</sub>-C<sub>6</sub> alkylene chain; a cycloalkylene group, preferably cyclohexylene; an  
 5 arylene group, preferably phenylene, tolylene or naphthalene.

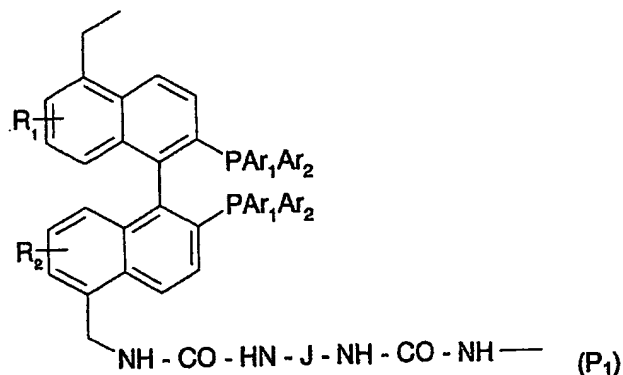
44. The polymer as claimed in either of claims 42 and 43, characterized in that it corresponds to the formula  
 10 (P) in which F<sub>1</sub> represents:

- a urea group (F<sub>1</sub>) resulting from the reaction of an aminomethyl group (X<sub>1</sub>) with an isocyanato group (Y<sub>1</sub>) or an isocyanato or isocyanatomethyl group (X<sub>1</sub>) with an amino group (Y<sub>1</sub>),
- 15 - a urethane group (F<sub>1</sub>) resulting from the reaction of an isocyanato or isocyanatomethyl group (X<sub>1</sub>) with a hydroxyl group (Y<sub>1</sub>) or a hydroxyl or hydroxymethyl group (X<sub>1</sub>) with an isocyanato group (Y<sub>1</sub>),
- 20 - an ester group (F<sub>1</sub>) resulting from the reaction of a carboxylic or ester group (X<sub>1</sub>) with a hydroxyl group (Y<sub>1</sub>) or a hydroxyl or hydroxymethyl group (X<sub>1</sub>) which a carboxylic or ester group (Y<sub>1</sub>),
- an amide group (F<sub>1</sub>) resulting from the reaction of  
 25 a carboxylic group (X<sub>1</sub>) with an amino group (Y<sub>1</sub>) or an aminomethyl group (X<sub>1</sub>) with a carboxylic group (Y<sub>1</sub>),
- an imine group (F<sub>1</sub>) resulting from the reaction of  
 30 an aminomethyl group (X<sub>1</sub>) with an aldehyde or ketone group (Y<sub>1</sub>).

45. The polymer as claimed in one of claims 38 to 44, characterized in that the polymer is a polyurea, polyamide, polyimide, polyimine, polyester or  
 35 polyurethane.

46. A process for preparing the optically active or inactive polymer described in one of claims 38 to 45, characterized in that a chiral or achiral diphosphine (I') and one or more monomers of formula (X) are  
5 polymerized.

47. The polymer as claimed in claim 42, characterized in that it is a polymer of polyurea type containing the repeating unit:



10

in which:

- R<sub>1</sub> and R<sub>2</sub>, which may be identical or different, represent a hydrogen atom or a substituent,
- Ar<sub>1</sub> and Ar<sub>2</sub> independently represent an alkyl,  
15 alkenyl, cycloalkyl, aryl or arylalkyl group,
- J represents a divalent hydrocarbon-based group of aliphatic, alicyclic and/or aromatic nature,
- the degree of polymerization is preferably between 2 and 100 and better still between 2  
20 and 50.

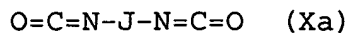
48. The polymer as claimed in claim 47, characterized in that the degree of polymerization is between 4 and 25 and preferably from 3 to 8.

25

49. A process for preparing the polyurea as claimed in either of claims 47 and 48, characterized in that a diphosphine bearing two -CH<sub>2</sub>-NH<sub>2</sub> groups is polymerized

with one or more di- or polyisocyanates.

50. The process as claimed in claim 49, characterized in that the diisocyanate is a diisocyanate of formula  
5 (Xa):

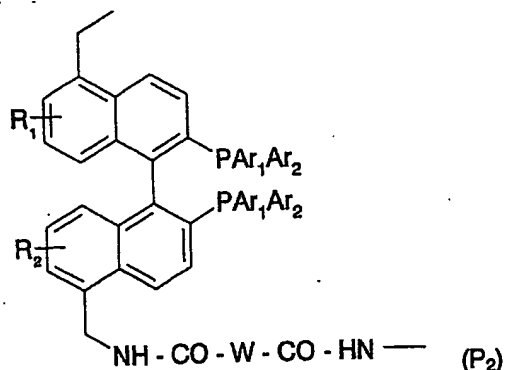


in which:

- J represents a divalent hydrocarbon-based group of aliphatic, alicyclic and/or aromatic nature.

10

51. The polymer as claimed in claim 42, characterized in that it is a polymer of polyamide type containing the repeating unit:



15 in which:

- $R_1$  and  $R_2$ , which may be identical or different, represent a hydrogen atom or a substituent,
- $Ar_1$  and  $Ar_2$  independently represent an alkyl, alkenyl, cycloalkyl, aryl or arylalkyl group,
- 20 - W represents a divalent hydrocarbon-based group of aliphatic, alicyclic and/or aromatic nature,
- the degree of polymerization is preferably between 2 and 100 and better still between 2 and 50.

25

52. A process for preparing the polyamide as claimed in claim 51, characterized in that a diphosphine bearing two  $-\text{CH}_2-\text{NH}_2$  groups is polymerized with a

dicarboxylic acid.

53. The process as claimed in claim 52, characterized in that the dicarboxylic acid advantageously  
5 corresponds to formula (Xb) below:



in which:

- W represents a divalent hydrocarbon-based group of aliphatic, alicyclic and/or aromatic nature.

10

54. The polymer as claimed in one of claims 9 to 12, 14 and 18, characterized in that the diphosphine corresponds to formula (I') in which Ar<sub>1</sub> and Ar<sub>2</sub> independently represent a (C<sub>1</sub>-C<sub>6</sub>)alkyl group, a phenyl  
15 group optionally substituted with one or more (C<sub>1</sub>-C<sub>6</sub>)alkyl or (C<sub>1</sub>-C<sub>6</sub>)alkoxy groups; or a (C<sub>4</sub>-C<sub>8</sub>)cycloalkyl group optionally substituted with one or more (C<sub>1</sub>-C<sub>6</sub>)alkyl groups.

20 55. The polymer as claimed in claim 54, characterized in that Ar<sub>1</sub> and Ar<sub>2</sub> are identical and preferably represent phenylene and R<sub>1</sub> and R<sub>2</sub> represent a hydrogen atom.

25 56. A transition metal complex comprising at least one polymer ligand as defined in one of claims 1 to 9, 38 to 45, 47, 48, 51, 54 and 55.

57. The complex as claimed in claim 56, characterized  
30 in that the transition metal is chosen from: rhodium, ruthenium, rhenium, iridium, cobalt, nickel, platinum and palladium.

58. The use of a chiral diphosphine or of an optically  
35 active polymer as claimed in one of claims 1 to 9, 38 to 45, 47, 48, 51, 54 and 55 as a ligand for the

preparation of a metal complex of a transition metal, which is useful in asymmetric catalysis.

5 59. The use as claimed in claim 58, characterized in that said complex is intended to catalyze the asymmetric hydrogenation of C=O, C=N or C=C bonds.

60. The use as claimed in either of claims 58 and 59, characterized in that the metal complex is a ruthenium, 10 rhodium or iridium complex and preferably a ruthenium or rhodium complex.

61. The use of a combination of a chiral diphosphine or of an optically active polymer as claimed in one of 15 claims 1 to 9, 38 to 45, 47, 48, 51, 54 and 55 with a diamine, for the selective reduction of ketones.

62. The use of a combination of a racemic diphosphine or of a racemic polymer as claimed in claim 58 with a 20 chiral diamine, for the selective reduction of ketones.

63. The use as claimed in either of claims 61 and 62, characterized in that the diamine is 1,2-diamino-1,2-diphenylethane.

25

64. The use as claimed in claim 58 of a complex of ruthenium and of a ligand of formula (Ia<sub>3</sub>) described in claim 18 or of polymers derived therefrom, for the asymmetric catalysis of hydrogenation reactions.